MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

TWM3431 – DIGITAL WATERMARKING

(All sections / Groups)

30 MAY 2016
9:00 A.M. – 11:00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 9 pages, including the cover page.
2. Answer **ALL** questions in **Section A** and **Section B**. Answer **ONLY ONE** question in **Section C**.
3. The distribution of the marks for each question is given.
4. Please print all your answers in the Answer Booklet provided.

SECTION A: Attempt **ALL** multiple choice questions. [10 marks]

1. [True or False] The original unaltered work is sometimes referred to as cover work.
   a. False
   b. True

2. [True or False] In a model of perceptual distance, combining the perceptibility of separate distortions give a single estimate for the overall change in a work. This is known as pooling.
   a. False
   b. True

3. [True or False] Transaction tracking is always known as fingerprinting because each copy of a work could be uniquely identified by the watermark.
   a. False
   b. True

4. [True or False] The source coder maps a message into a sequence of symbols drawn from some alphabet.
   a. False
   b. True

5. [True or False] Robust watermarks are commonly used for tamper detection.
   a. False
   b. True

6. The textual copyright notice for visual works can be any of the following, except:
   a. ® 2016 Anna
   b. Copyright 2016 Elsa
   c. © 2016 Anna
   d. Copr. 2016 Elsa

7. In _____ communications, the modulation is performed according to a secret key, which spreads the signal across a wider bandwidth.
   a. spread-spectrum
   b. traditional network
   c. encrypted network
   d. multiplexed

CONTINUED .....

8. In the evaluation of signal processing systems, there are TWO different types of perceptibility that may be judged. What are them?
   a. Robustness and secure
   b. Fidelity and robustness
   c. Quality and secure
   d. Fidelity and quality

9. A digital watermark is called _____ if the watermarked content is perceptually equivalent to the original unwatermarked content.
   a. robust
   b. inseparable
   c. fragile watermark
   d. imperceptible

10. If the adversary obtains several different works that contain the watermark, he could perform _____.
   a. Brute force attacks
   b. masquerade attacks
   c. denial of service attacks
   d. collusion attacks

CONTINUED .....

SECTION B: There are **FOUR** questions only. Answer **ALL** the questions

QUESTION 1

(a) John does not agree that cryptography is able to protect copyrighted contents thoroughly from piracy. In your opinions, what are the reasons of the disagreement?

[3 marks]

(b) Paper watermarking appeared in year 1282 in Italy. The marks were made by adding thin wire patterns to the paper molds. Therefore, the paper would be slightly thinner where the wire was and hence more transparent. What are the three major purposes of the earliest paper watermarks?

[3 marks]

(c) It is discourage to have textual copyright notices in owner identification of a work. Discuss the major limitation of this practice with an appropriate example.

[2 marks]

(d) Digital watermarking is extensively adopted by the industry for various purposes. Briefly explain the following watermarking applications:

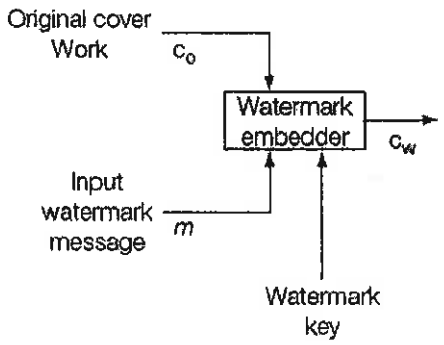
i. Broadcast monitoring
ii. Transaction tracking

[2 marks]

CONTINUED .....

QUESTION 2

(a) The figure below illustrates the embedding process in a model of watermarking as multiplexed communications.



Given that it is using a blind detector, propose an equivalent watermark detector. Explain your answer with an appropriate diagram.

[5 marks]

(b) In copy control application, which kind of detection, i.e. informed detection or blind detection, is preferable? Justify your answer.

[2.5 marks]

(c) In transaction tracking application, which kind of detection, i.e. informed detection or blind detection, is preferable? Justify your answer.

[2.5 marks]

CONTINUED .....

QUESTION 3

(a) John is a digital watermarking designer. He is assigned to design message marks and linear correlation will be used as the detection metric. "Good code separation" is one of requirements in his design. In your opinion, what can you understand about "good code separation"? Explain it in your own words.

[3 marks]

(b) Modulation can be performed in a variety of ways. Briefly describe the following modulation techniques:

i Time-division multiplexing
ii Space-division multiplexing

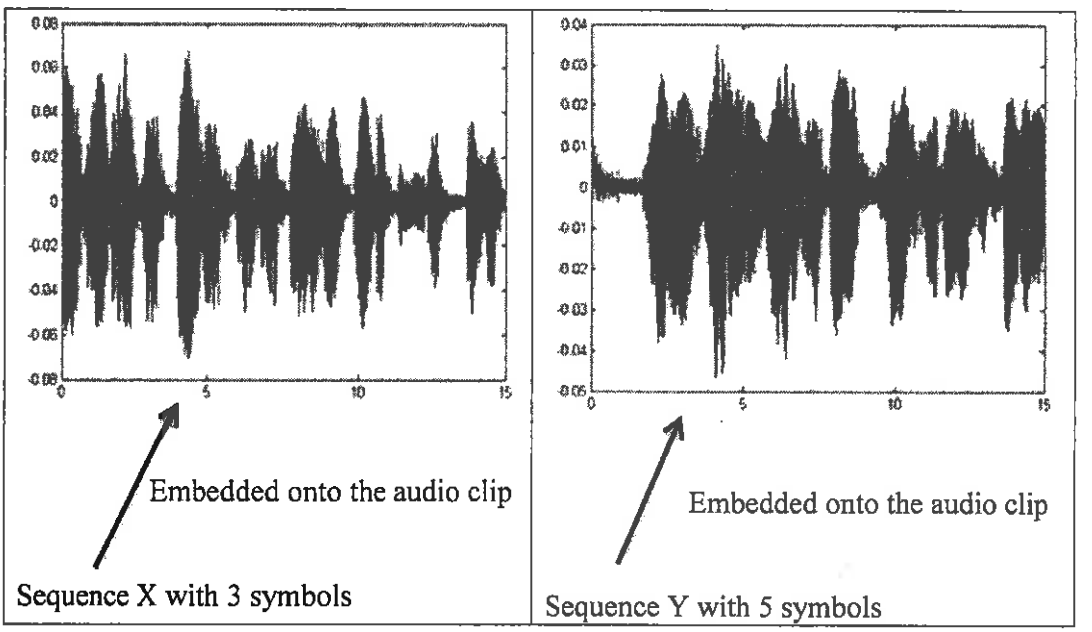
[2 marks]

(c) You have two sequences of symbols:

i Sequence X consists of THREE (3) symbols
ii Sequence Y consists of FIVE (5) symbols

You wish to embed the two sequences, respectively, into TWO audio clips (as shown below) of length 15 seconds.
Suggest a way to accomplish the task.

[3 marks]

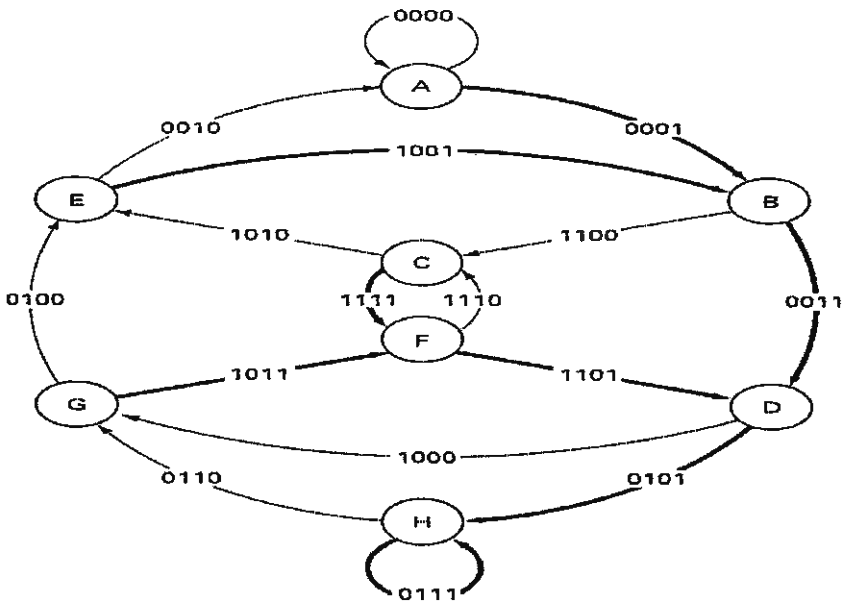


CONTINUED .....

(d) Referring to the figure below of Eight-State Convolutional Code, encode a 4-bit sequence of

i 1011

ii 1001



[2 marks]

QUESTION 4

(a) Although human evaluation measurement techniques could provide very accurate information about fidelity of watermarked content, perceptual fidelity studies involving human observers are rare.
With your best knowledge, what are the TWO drawbacks of human evaluation measurement techniques?

[2 marks]

(b) John wishes to conduct perceptual quality studies involving human evaluation. Due to limited budget and time, he plans to use a small number of subjects and perform only few numbers of trials.
Do you agree with John's plan? Explain your answer.

[4 marks]

(c) Two alternatives, forced choice (2AFC) is a classical experimental paradigm for measuring perceptual phenomena. You are assigned to adopt this 2AFC technique to test the quality impact of a watermarking algorithm. How to you accomplish this task?

[4 marks]

CONTINUED ....

SECTION C: There are **TWO** questions only. Answer **ONE** of the questions.

QUESTION 1

(a) It is not always appropriate to embed a watermark in all coefficients of a work's representation. Hence, it is better to place as much as of the watermark as possible into reliable coefficients, i.e. perceptually significant coefficients. However, a major problem with embedding in perceptually significant coefficients is that it is directly opposed to the objective of creating imperceptible watermarks.
Suggest TWO solutions to the problem. Explain your answer.

[4 marks]

(b) There are multiple approaches could be used to make watermark robust. Briefly explain the following approaches:

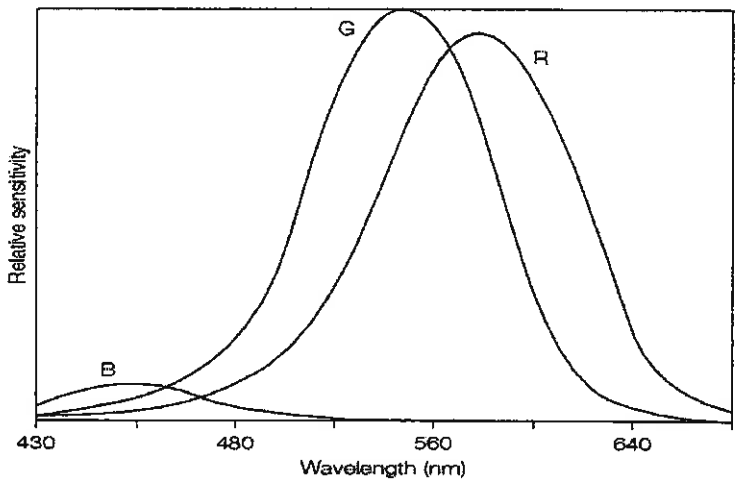
i Embedding in coefficient of known robustness

ii Inverting distortions in the detector

[2 marks]

(c) Most HVS (Human Visual System) models in image processing use the basic properties of human vision. Frequency sensitivity is one of the popular properties being used. Frequency sensitivity determines the human's eye sensitivity to various spatial frequencies.

You conduct an experiment to measure the frequency sensitivity. The observers are presented with an isolated stimuli and their perception of these stimuli is tested. At the end of the experiment, the spectral sensitivity for three different color systems, i.e., R-Red, G - Green and B - Blue, in the normal human color vision is respectively plotted in a graph below.



Analyze this graph and suggest a way to embed watermark signals in RGB images.

[4 marks]

CONTINUED ....

QUESTION 2

(a) John successfully performed an unauthorized decoding on Mary's watermarked image. By decoding the watermarked image, John managed to infringe the original image.

If you are a cryptography practitioner, propose ONE solution to overcome this problem. Explain your answer.

[5 marks]

(b) In some applications, minimal distortions introduced by embedding a few-bit, e.g. 160-bit, signature might be unacceptable. For example, in medical application, any modifications of an image might become an issue in a malpractice suit. Hence, this leads to an interest in using erasable watermarks for authentication.
Describe the steps for generating an erasable watermark.

[4 marks]

(c) Compare and contrast exact authentication and selective authentication.

[1 mark]

END OF PAPER